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POST-WAR DEVELOPMENT OF INDIAN FISHERIES

INDIA'S resources of fisheries are rich and extensive. The Bay of Bengal and the Arabian Sea are abundant in tropical species of food-fishes. Besides the marine fisheries, the inland waters such as the rivers, lakes and tanks abound in good fish and constitute a substantial source of food supply. Unfortunately, no serious attempts have been made to develop and exploit these fisheries. Fishing is, no doubt, practised by the coastal fishermen but their fishing craft is primitive and the mode of disposal of fish unscientific and uneconomical. Fish is hardly supplied a few miles interior of the coastal line. In spite of the poor fishing methods used by the fishermen the average quantity of fish landed by a fisherman on the Malabar Coast works out to seven tons a year which exceeds the corresponding average for the Japanese fisheries. This instance is cited to emphasize the richness of the West Coast fishery. But the total catch of the whole of India which is estimated to be 7,000,000 tons per year is shockingly poor compared with the vast population of the country.

Pioneer workers in the field of fishery development in India such as Dr. Francis Day, Sir Frederick Nicholson, Sir K. G. Gupta, Dr. B. Sundara Raj, Dr. S. L. Hora, and others have repeatedly pointed out the backward condition of the Indian fisheries and have urged the importance of organising fishery development and fishing industry. The Royal Commission on Agriculture in India have observed, "We have been greatly struck by the comparative failure to develop the fisheries of the country . . . The addition of fish to the diet of the cultivator seems to be the most promising way of securing that improvement in his nutrition which is so much needed and all measures practicable to this end should be taken". The Overseas Committee of the Indian Science Congress Association has stressed the need for the formation of a Central Executive Fishery Research Council work-

ing under one of the departments of the Government of India and the establishment of a Fishery Research Institute for the proper development and conservation of the valuable fisheries of Indian waters. In a memorandum (Government of India Press, New Delhi, 1944), Dr. B. Prashad has made similar recommendations as those of the Overseas Committee and has given a five-year plan for the development of fisheries in India with particular reference to the importance of scientific research both biological and technological. An account of the prawn fisheries of India and their importance as sources of food production has been given by Dr. B. Chopra in his Presidential Address to the Indian Science Congress (1943). It is gratifying to note that the importance of fishery development is being felt in different parts of India. Some basic work has already been done in Bengal, Madras, Bombay, Punjab, Travancore, Mysore, Hyderabad and Baroda. It is true that so long as the fisheries is a "transferred" subject the main responsibility of organising and exploiting the fisheries rests with the provincial and state governments, but the problems connected with the fishery development in India as a whole are so varied and complicated that they cannot be solved without proper co-ordination and financial assistance by a strong Central Advisory Body in Government of India. The Overseas Committee in recommending the formation of such a body have rightly observed, "Many fishery problems are, moreover, common to several provinces, or, indeed, to the whole of India, and to attempt their solution by a number of poorly staffed and disconnected units—even if it were possible—could only result in overlapping and in wasted efforts". The establishment of the Fishery Research Institute and the Advisory Fishery Research Council as suggested by Dr. Prashad is as urgent as it is essential for the successful solution of the basic problems of fishery development.

There are numerous difficult problems to be solved in connection with the development of Indian fisheries. Dr. Prashad states, "The intricate problems concerned with the proper development and exploitation of the fisheries are often so much more difficult of elucidation and solution than in other industries, that only a carefully planned, long-term scheme of research and experimental work would seem to meet our difficulties. Various physical and biological factors which influence the abundance or scarcity of fishes in any maritime area are depth, temperature and salinity of the water, nature of the bottom, weather conditions, state of the tide, time of the day, season of the year, migrations of the fishes following those of organisms which form their food or in response to reproductive instinct, and several other factors. In European and American waters, sustained and well-directed research by large bands of trained marine biologists of all nations extending over many years has gone a long way towards elucidating the relative influences of nearly all these factors, and making available detailed information on the biology, age, life-histories, food, rates of growth, migrations, etc., of most of the important food-fishes. No such data are available for Indian species of marine fishes. There are similar problems in regard to the freshwater and estuarine fisheries of India awaiting solution, but no real progress is possible until accurate and detailed information on these basic points becomes available." Other problems connected with the fishing industry relate to the adoption of deep-sea fishing, devising better fishing craft and fishing appliances, organising curing, smoking, canning, refrigeration, quick transportation, marketing of fishes and such others. Further there is the problem of organising subsidiary industries such as the manufacture of fish-oils, guano and fish-meal. It may further be pointed out that the hydrographical and biological conditions of the fisheries and the habits of fishes in our tropical waters are so different from those in the Western countries that a blind application of the Western fishery

principles to solve these problems may prove inadequate and often useless. It is, therefore, necessary that each problem has to be carefully studied with particular reference to local conditions and appropriate solutions found.

The magnitude of the importance of fishery development in India cannot be over-emphasized. No dietetic improvement can be planned for the people of India without a programme for the rational exploitation of its fishery resources. The various provincial and the state governments in this country particularly the Central Government should devote its earnest attention to the subject of fishery development and give the subject an important place in their Post-War Planning.

Till such time as the Central Advisory Fishery Research Council and the Fishery Research Institute are formed, the scope of the "Fish Committee" of the Imperial Council of Agricultural Research may as well be widened to secure an effective and fruitful co-ordination of fishery investigations among different provinces and states. The Fishery Experts in different parts of India should be invited to serve on the reconstituted and enlarged committee. They have acquired an intimate knowledge of the present condition of the fisheries in their respective provinces and states, which will be very helpful in formulating a correct policy regarding the organisation of fishery development in India. Important investigations can immediately be started with the co-operation of fishery departments and scientific institutions in the country. The Madras Zoological Research Laboratory has recently carried out some outstanding work and with additional staff and equipment, the Institution will no doubt be able to successfully solve marine biological problems connected with fishery research. Similarly the Marine Biological Stations at Trivandrum and West-Hill can conduct such investigations on the West Coast. The example of the Department of Zoology of the Calcutta University which has worked out certain fishery problems, is worthy of emulation by other universities in India.

NUTRITIVE VALUE OF DEHYDRATED VEGETABLES

DEHYDRATED vegetables are now being manufactured in large quantities in many belligerent countries and it is important that their nutritive value should be studied. A good deal of work on this subject has been carried out in the Indian Research Fund Association Nutrition Research Laboratories, Coonoor, under Dr. W. R. Aykroyd, says the report of the Scientific Advisory Board of the Indian Research Fund Association for the year 1943.

Steam-blanching cabbage was found to lose vitamin C more rapidly on storage than cabbage blanched by dipping in boiling water. Loss of vitamin C in dehydrated vegetables prepared by the so-called "pre-cooking" method was more rapid than in vegetables prepared by other processes. The general conclusion arising out of a considerable amount of work on the vitamin C content of dehydrated vegeta-

bles is that these cannot be relied upon as antiscorbutics after a period of a few months' storage.

While carotene is somewhat more stable than vitamin C in dehydrated vegetables, very appreciable losses occur on storage. After 20 weeks' storage at 98° F., bitter gourd, cauliflower, carrot, pumpkin and potato lost from 35 to 65 per cent. of their original carotene content. Losses in the mineral content of dehydrated vegetables during reconstitution and cooking amounted to 60 per cent. When in the U.S.A., attending the United Nations Conference on Food and Agriculture, Doctor Aykroyd collected considerable literature on the effect of dehydration on the nutritive value of vegetables and other foods, a subject which is being intensively studied in England, Canada, the U.S.A. and Australia,

GLANDS AND GLAND PRODUCTS

IV. Seasonal Variations in the Total Iodine and Thyroxine Contents of the Thyroid Glands of South Indian Animals

BY

B. B. DEY, P. S. KRISHNAN AND M. GIRIRAJ

(Presidency College, Madras)

THE thyroid stands unique amongst all the endocrine glands as regards susceptibility to geographic and seasonal variations. Glands from animals belonging to certain regions (especially the so-called 'goitrous regions') have been shown to contain very low iodine in marked contrast to the high iodine content reported for South Indian animals (Dey *et al.*).¹ That there is a marked seasonal variation in the iodine content of the thyroid was established by Seidell and Fenger² and by Fenger³ who analysed thyroid glands of hog, beef and sheep collected from the Mississippi valley and showed that during the summer months the glands might contain as much as three times the amount of iodine in the winter months. This observation has been confirmed by Veil and Sturm⁴ and also by Kendall and Simonsen⁵ who showed marked seasonal variations not only in the total iodine but also in the amount of thyroxine which could be isolated. The extensive investigations carried out by Riddle⁶ on the thyroids of doves have shown marked changes in the weight and iodine content of the gland with changes of season. Remarkably enough, Scottish and English animals show a fairly constant iodine content for desiccated thyroid throughout the seasons of the year.⁷

Two theories have been put forward to explain this seasonal variation in the iodine contents. Cameron⁸ and his school are of opinion that the predominant factor is the diet; during summer months the animals have free access to pastures whereas during the winter months they are confined indoors and fed on artificial diet. This theory is supported by numerous observations that the iodine content of thyroid can be artificially increased by feeding on diet rich in iodides (*cf.* Hunter and Simpson).⁹ Fenger,³ however, has suggested that the temperature factor is the most important of all in producing seasonal variation in the iodine content of the thyroid. There is an increased metabolism at lower temperatures and more of the hormonal secretion is poured out from the gland thereby depleting the latter of its iodine reserves; these effects are reversed during the summer months. This theory finds support in the experimental observations of Mills¹⁰ who found that high temperatures cause diminished activity of the thyroid and of Cramer¹¹ who showed that response to cold increases thyroid activity.

This seasonal variation in the iodine content of the thyroid glands has more than theoretical significance. Kendall¹² has pointed out that for the isolation of thyroxine the thyroid material available in the United States from the months of October to June is not practicable from a commercial point of view; in June, July and August the amount of thyroxine may

be almost five times as much as the amount which can be isolated from the same weight of hog glands in January and February.

The thyroid glands of cattle, sheep and pigs available from the Madras Corporation Slaughter House were collected during the twelve months, August 1943 to July 1944, desiccated and analysed for total and thyroxine iodine by standard methods. The results, which are represented in the following table,

TABLE I
Analysis of Thyroid Glands (desiccated)
collected during the twelve months
of the year

Month	Animal	Total Iodine (per cent.)	Thyroxine Iodine (per cent.)	% Ratio Thy- roxine Iodine Total Iodine
August 1943	Cattle	0.9113	0.3530	38.75
	Sheep	0.6650	0.2593	38.99
	Pig	0.9150	0.3904	42.67
Sept.	Cattle	0.9492	0.3861	40.67
	Sheep	0.7060	0.2959	41.91
	Pig	0.8314	0.3860	46.54
Oct.	Cattle	0.9642	0.3533	36.64
	Sheep	0.6479	0.2669	41.2
	Pig	0.8949	0.3949	44.14
Nov.	Cattle	0.9429	0.3620	38.39
	Sheep	0.6321	0.2607	41.24
	Pig	0.8590	0.3639	42.36
Dec.	Cattle	0.9772	0.4045	41.39
	Sheep	0.6648	0.2770	41.67
	Pig	0.8325	0.3622	43.60
Jan. 1944	Cattle	0.9917	0.3964	39.96
	Sheep	0.7237	0.2904	40.14
	Pig	0.8151	0.3487	42.62
Feb.	Cattle	1.030	0.4041	39.23
	Sheep	0.7602	0.2924	38.47
	Pig	0.7833	0.3155	40.27
March	Cattle	0.9647	0.3691	38.25
	Sheep	0.7496	0.2678	35.72
	Pig	0.7715	0.3736	48.42

TABLE I—(Contd.)

Month	Animal	Total Iodine (per cent.)	Thyroxine Iodine (per cent.)	% Ratio Thy- roxine Iodine Total Iodine
April	Cattle	0.9552	0.3590	37.58
	Sheep	0.7127	0.2636	36.99
	Pig	0.5664	0.3032	53.53
May	Cattle	0.9839	0.3420	34.75
	Sheep	0.7476	0.2716	36.33
	Pig	0.8038	0.3271	40.69
June	Cattle	0.9954	0.3623	36.40
	Sheep	0.7962	0.2913	36.59
	Pig	0.8109	0.3411	42.07
July	Cattle	1.052	0.3638	34.58
	Sheep	0.7678	0.2903	37.80
	Pig	0.8260	0.3432	41.56

indicate that there is practically no seasonal variation in the total or thyroxine iodine content of the glands.

Glands collected all round the year in South India can, therefore, be utilized for the preparation of thyroxine and thyroid extracts.

The expenses of these investigations were met by a grant from the Board of Scientific and Industrial Research, to whom our grateful thanks are due.

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THE SUGAR RESEARCH FOUNDATION

A LONG-RANGE programme of research on sugar will be undertaken at the Massachusetts Institute of Technology in co-operation with the newly established Sugar Research Foundation of New York, which has made a grant of \$125,000 for a five-year programme of research. Plans for the project were made public in a joint announcement by President Karl T. Compton, of the Massachusetts Institute of Technology, and Joseph F. Abbott, President of the Sugar Research Foundation.

The Foundation was established for the development of fundamental knowledge in the field of carbohydrate chemistry, biochemistry and nutrition. Membership is open to all producers and processors of sugar in the United States, Puerto Rico, Hawaii and Cuba.

Dr. Compton, in announcing the co-operative arrangement, said:—

"The new programme is another step in the Institute's long-established policy of co-operation with industry in fundamental research to improve industrial processes and develop new products. The project we are about to undertake is a pioneering plan of national significance in that it promises substantial benefits, not for one organization, but for an entire industry.

"The rewards of scientific research in co-operation with industry are by no means restricted to the development of new products, for the discovery of new knowledge in any branch of science invariably proves to be a contribution to advanced technical education in associated fields. Thus this sponsored research on sugar makes it possible for the Institute to continue and expand the programme of fundamental investigations in the field of carbohydrate

chemistry which has been in progress for several years.

"We are particularly glad that Dr. Robert C. Hockett, who has been given leave of absence from our Faculty to become the scientific director of the Sugar Research Foundation, will be in charge of this broad programme.

"The sugar industry is to be commended for its public service and vision for making possible this objective research. I feel sure it will be rewarded by results of great scientific value to the public."

Commenting on the new laboratory, Joseph F. Abbott, President of the Sugar Research Foundation, said in part:—

"It is anticipated that the chemical studies conducted under the arrangement with the Massachusetts Institute of Technology will not only extend knowledge of the rôle of sugar and other carbohydrates in the human body, but also will unfold wholly new industrial uses for sugar and its derivatives. It is our hope that the collaboration between the industry and this outstanding technical Institution will prove to be of great benefit to science and the general public as well as to the industry.

"An important objective of this broad research programme will be the training of scientists in the field of carbohydrate chemistry to prepare them for service in the industry for further technical studies. Provision has also been made for fellowships for young graduate students who are candidates for advanced degrees to permit them to continue their work in this field."—*Science*, December 10, 1943, p. 509.

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THE P.A. FACTOR AND PHENYL-HYDRAZINE ANÆMIA

EXPERIMENTAL animals made anæmic with phenylhydrazine have been used for some time in this laboratory for the study of the hæmopoietic action of amino-acids and proteins with very satisfactory results (Yeshoda, 1942¹; Damodaran & Vijayaraghavan, 1943²; Yeshoda, 1943³). It occurred to us to investigate if the method could not be used for the biological assay of the factor present in liver extracts active in pernicious anæmia (hereafter referred to as the P.A. factor) for which no satisfactory method at present exists. Similarity of the blood pictures in pernicious anæmia and experimental phenylhydrazine anæmia has been frequently noted (cf. Paton and Goodall, 1903⁴; Price Jones, 1911⁵). Erdos (1935)⁶ has shown that in rabbits made anæmic by means of phenylhydrazine the onset of anæmia is delayed by the administration of liver extract and has suggested the utilization of this effect for comparing the potency of such extracts. On the contrary Wright and Arthur (1930)⁷, who also experimented upon rabbits, came to the

conclusion that "the regeneration from anæmia resulting from the injection of phenylhydrazine or from hæmorrhage is not affected by the administration of the substance effective in pernicious anæmia".

In the present experiments it has been found that liver extract exerts a markedly beneficial effect on the recovery of rats from phenylhydrazine anæmia. All the animals received a basal diet containing 3 per cent. casein which has been shown in previous experiments to be the minimum amount of protein to bring about normal blood-regeneration (Damodaran and Vijayaraghavan, loc. cit.). The P.A. factor was given orally in the form of Cohn's Fraction G (Cohn, Minot and Murphy, 1927⁸). Starting from the fourth day after injection of phenylhydrazine, when the anæmia reaches its peak, 1 ml. of the extract was fed to each animal daily. Aqueous solutions containing 5 per cent., 2.5 per cent., and 1.25 per cent. of Fraction G were tried on three different groups of animals. The control group received no liver extract.

Table I which gives the average values of

TABLE I

Group	Number of animals	Average RBC millions/c.mm.				Average Hb gm./100 ml.			
		4th Day	12th Day	% Inc.	Excess over control	4th Day	12th Day	% Inc.	Excess over control
A 5% Liver Extract	6	3.89	7.56	94.4	42.3	8.86	13.62	53.7	-1.4
B 2.5% Liver Extract	6	3.46	6.03	74.3	22.2	8.40	13.31	58.4	3.3
C 1.25% Liver Extract	6	3.06	6.25	58.1	6.0	9.13	13.96	52.9	-2.2
Control	5	4.01	6.10	52.1	—	8.98	13.93	55.1	—

R.B.C. and haemoglobin for the four groups of animals shows clearly that liver extract in suitable concentrations exercises a marked effect on the rate of red blood cell regeneration in phenylhydrazine anaemia. The results also indicate that in one important respect the haemopoietic action of the liver extract differs from that of amino-acids and proteins previously reported. The action of liver extract lies solely in the increase of erythrocytes without a corresponding increase in the percentage of haemoglobin. This is in conformity with the view that amino-acids and proteins provide the structural material for the formation of haemoglobin while the action of the P.A. factor is on the haemopoietic apparatus, i.e., on the reticulo-endothelial system.

Although Cohn's Fraction G is not known to contain any haemopoietically active substance other than the P.A. factor it would be rash to conclude from these experiments that the effects noted are due in fact to this factor. Wright and Arthur (*loc. cit.*) came to their negative conclusion quoted above in spite of finding that the anaemia induced by phenylhydrazine is much less acute in liver-fed rabbits than in control animals receiving no liver treatment. These authors were inclined to the view that the mitigating influence of liver extracts was not due to the P.A. factor but to the presence in it of some other substance which neutralised the destructive effect of phenylhydrazine on blood corpuscles. Although their experimental data hardly bear out this view there is no doubt that much further experimentation, accompanied by clinical trials, will be necessary before the regeneration of erythrocytes in phenylhydrazine anaemia can be accepted as a suitable method for the assay of the P.A. factor.

University Biochemical
Laboratory, Madras,
August 9, 1944.

M. DAMODARAN.
P. K. VIJAYARAGHAVAN.

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DERIVATIVES OF 3-(p-METHOXY-PHENYL)-CYCLOHEXANONE

THE following is a brief account of experiments of an exploratory nature which were made with the object of preparing 3-(p-methoxyphenyl)-cyclohexanone required in connection with another research.

5-p-Methoxyphenyldihydroresorcinol¹ when treated with phosphorus trichloride² readily yields 5-chloro-3-(p-methoxyphenyl)- Δ^5 -cyclohexenone, m.p. 70° which on reduction with sodium and moist ethereal solution, gives 3-(p-methoxyphenyl)-cyclohexanol, m.p. 83-84°. The latter on cautious oxidation with

Beckmann's chromic acid mixture furnishes, 3-(p-methoxyphenyl)-cyclohexanone, b.p. 155°/4 mm. (semicarbazone, m.p. 194°). The same ketone can also be made directly by the reduction of 5-chloro-3-(p-methoxyphenyl)- Δ^5 -cyclohexenone by means of hydrogen in presence of colloidal palladium.³

The unstable δ -lactonic ester⁴ derived from ethyl γ -anisoylbutyrate, zinc and ethyl bromoacetate on hydrolysis with 10 per cent. alcoholic potash furnishes an unsaturated dicarboxylic acid, $C_{11}H_{16}O_6$, m.p. 153-154°. The corresponding diethyl ester, b.p. 189-192°/4 mm. readily absorbs one equivalent of hydrogen in presence of Adams platinum catalyst giving ethyl β -(p-methoxyphenyl)-pimelate, b.p. 190°/5 mm. This on hydrolysis affords β -(p-methoxyphenyl)-pimelic acid, m.p. 92-93°. The latter on ketonisation with acetic anhydride smoothly furnishes 3-(p-methoxyphenyl)-cyclohexanone, described above, identified by its b.p. 148-150°/5 mm., and semicarbazone, m.p. 194°. The unsaturated acid, m.p. 153-154°, under precisely similar conditions affords 3-(p-methoxyphenyl)- Δ^2 -cyclohexenone, m.p. 84°, semicarbazone, m.p. 217-219°, evidently identical with the ketone represented by Banerjee⁵ as 3-(p-methoxyphenyl)-cyclohexanone.

Finally, the unsaturated ketone, m.p. 84°, described above, was synthesised by the action of ω -chloro-p-methoxypropionophenone⁶ on ethyl sodio-acetoacetate followed by alkaline hydrolysis of the resulting product, which leaves no further room for doubt regarding the structure assigned to this compound.

It follows, therefore, that Banerjee's ketone, m.p. 83°, must be correctly represented as 3-(p-methoxyphenyl)- Δ^2 -cyclohexenone, although the analytical results actually found for the ketone by Banerjee are in excellent accord with those calculated for 3-(p-methoxyphenyl)-cyclohexanone.

My best thanks are due to Dr. J. C. Bardhan for his kind interest in the work.

University College of Science
and Technology, Calcutta,
July 21, 1944

PIYUSKANTI CHAUDHURI.

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SYNTHESES OF 1-NAPHTHALENE-SUBSTITUTED ISOQUINOLINES

IN connection with a scheme for study of isoquinoline bases containing the naphthalene ring which may prove physiologically active it became necessary to investigate the synthesis of substances containing naphthyl residues in the 1-position of the isoquinoline molecule. The latter had in common homopiperonylamine as the starting material. The necessary intermediate N-acyl homopiperonylamides were

obtained in excellent yields by the interaction of molecular proportions of homopiperonylamine and the respective acid chlorides in the presence of dil. NaOH. The amides now prepared are α -naphthoyl homopiperonyl amide, m.p. 130-31°, β -naphthoyl homopiperonyl amide, m.p. 140-41° and α -naphthylacetyl homopiperonyl amide, m.p. 129-31°. These separated from alcohol in colourless needles. On being subjected to the dehydrating action of POCl_3 in toluene, α - and β -naphthoyl homopiperonyl amides underwent the classical Bischler-Napieralsky reaction¹ and furnished in satisfactory yields the corresponding 1-naphthyl dihydro isoquinolines: 1, α -naphthyl, 3:4-dihydro, 6:7-methylenedioxy isoquinoline separated from petroleum ether in colourless needles, m.p. 109-10° (Picrate, orange yellow needles from alcohol, m.p. 164-65°; Picrolonate, yellow needles from alcohol-acetic acid, m.p. 228-31° dec.); 1, β -naphthyl 3:4-dihydro, 6:7-methylenedioxy isoquinoline separated from alcohol in colourless, prismatic needles, m.p. 140-41° (Picrate, yellow needles from alcohol-acetic acid, m.p. 191-92°; Picrolonate, yellow needles from alcohol, m.p. 189-93° dec.). On the other hand, cyclodehydration of α -naphthylacetyl homopiperonyl amide through the agency of POCl_3 in boiling toluene was by no means smooth. The main product of the reaction was a neutral, chlorinated compound, m.p. 258-59° dec. At the same time a basic substance, presumably the desired 1, α -naphthyl methyl, 3:4-dihydro, 6:7-methylenedioxy isoquinoline, was also formed in poor yields. Furthermore, the aforementioned base and even its hydrochloride in solution were characteristically unstable, a property which may be ascribed to the presence of the reactive methylene group linking the isoquinoline and naphthalene nuclei. Nevertheless, it has been possible to characterise the 1, α -naphthylmethyl, 3:4-dihydro, 6:7-methylenedioxy isoquinoline as its picrate separating from alcohol-acetic acid in orange yellow crystals, m.p. 166-68° dec.

The customary procedure of heating with zinc and dil. sulphuric acid was inapplicable to the reduction of 1, α -naphthyl, 3:4-dihydro, 6:7-methylenedioxy isoquinoline to the corresponding tetrahydro derivative, since it led to the formation exclusively of a neutral, metal-free compound separating from alcohol in colourless needles, m.p. 252-54° dec. The attempt to reduce 1, β -naphthyl, 3:4-dihydro, 6:7-methylenedioxy isoquinoline by means of zinc and dil. sulphuric acid likewise did not meet with success but gave rise to a nonbasic, metal-free product separating from alcohol in colourless needles, m.p. 241-43° dec. An insight into the nature of the two neutral substances as also that of the chloro compound encountered in the cyclisation of α -naphthylacetyl homopiperonyl amide has not yet been gained.

It is hoped to investigate in detail the cyclisation if α -naphthylacetyl homopiperonyl amide and the reduction of the isomeric 1-naphthyl, 3:4-dihydro, 6:7-methylenedioxy isoquinolines to the respective tetrahydro-bases changing, necessarily, the experimental conditions. The

results of these studies under way will form the subject of a further communication.

Presidency College,
Madras,
July 26, 1944.

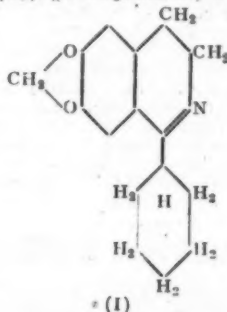
B. B. DEY.
S. RAJAGOPALAN.

1. Bischler and Napieralsky, *Ber.*, 1893, 26, 1903.
Pictet et al., *Ibid.*, 1909, 42, 1973, 1979; Decker et al.,
Ibid., 1909, 42, 2075; *Ann.*, 1913, 395, 290.

1-CYCLOHEXYL NORHYDRASTININE AND DERIVATIVES

In a previous communication,¹ it was stated that the reduction of 1-benzyl, 1-cyclohexyl and 1-cyclohexyl methyl norhydrastrinines with aluminium amalgam would be studied. Due to certain difficulties this has not been possible, but 1-cyclohexyl norhydrastrinine and its derivatives prepared for purposes of this work have not been described in literature and are, therefore, reported here.

Cyclohexyl-3, 4 methylenedioxy phenyl ethyl amide was prepared by the action of cyclohexane carboxylic acid chloride on homopiperonyl amine (m.p. 135-36°; Found: N, 5.1; $\text{C}_{16}\text{H}_{19}\text{O}_2\text{N}$ requires N, 5.8 per cent.)



The amide was converted by phosphorous oxychloride in boiling toluene to 1-cyclohexyl norhydrastrinine (I). (Prisms from methanol or clusters of interlacing rhombic needles from ligroin, m.p. 82°. Found: N, 5.6; $\text{C}_{16}\text{H}_{19}\text{O}_2\text{N}$ requires N, 5.5 per cent.; Picrate, crystallised from glacial acetic acid in rectangular blocks, m.p. 221°; Methiodide, m.p. 222-24°).

On reduction with zinc and sulphuric acid, the dihydro isoquinoline (I) gave in good yield 1-cyclohexyl norhydrohydrastrine (Twig-shaped clusters of rhombic needles on slow crystallisation from petroleum ether, m.p. 47°; Picrate, crystallised from dilute alcohol, m.p. 206°; Hydrochloride sparingly soluble, hexagonal blocks, m.p. 244°; Hydrobromide, m.p. 237°; the nitroso derivative was formed at 0°, but decomposed instantaneously at room temperature).

Presidency College,
Madras,
August 3, 1944.

B. B. DEY.
T. R. GOVINDACHARI.

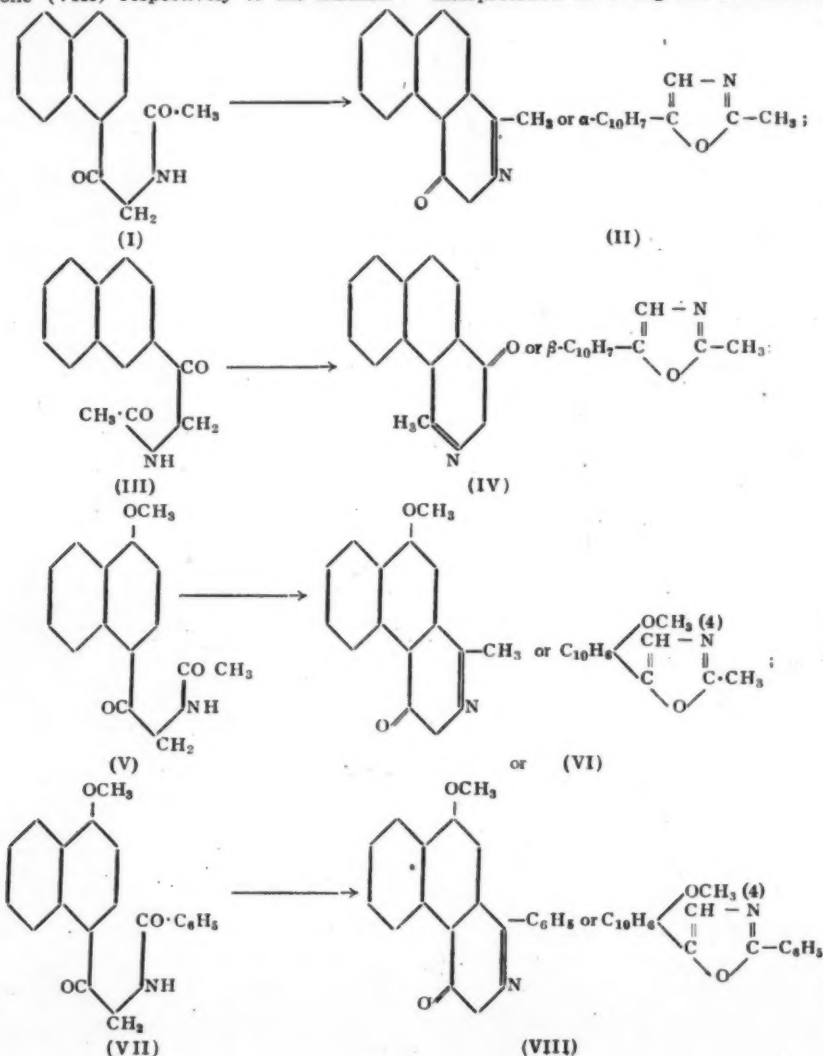
1. Dey and Govindachari, *Proc. Nat. Inst. Sci.*, 1940, 6, 219.

OXAZOLES DERIVED FROM THE NAPHTHALENE RING

SOME years ago we reported¹ the synthesis of 1-methyl, 3:4-dihydro, 4-keto, 5:6-benzoisoquinoline (II), 1-methyl, 3:4-dihydro, 4-keto, 7:8-benzoisoquinoline (IV), 1-methyl, 3:4-dihydro, 4-keto, 7-methoxy, 5:6-benzoisoquinoline (VI) and 1-phenyl, 3:4-dihydro, 4-keto, 7-methoxy, 5:6-benzoisoquinoline (VIII) by subjecting N-acetyl, ω -amino, α -acetonaphthone (I), N-acetyl, ω -amino, β -acetonaphthone (III), 4-methoxy, N-acetyl, ω -amino acetonaphthone (V) and 4-methoxy, N-benzoyl, ω -amino acetonaphthone (VII) respectively to the Bischler-

Napieralsky reaction² of heating with phosphoryl chloride in toluene.

The assumption of the structures of the feebly basic substances, II, IV, VI and VIII, resulting from the dehydration of the amides, I, III, V and VII, was based by analogy on the report of Buck³ that homoveratroyl ω -amino acetoveratrone gave rise, under similar conditions to a 4-keto isoquinoline derivative. However, the report of Buck has subsequently been critically examined by Young and Robinson⁴ who showed that the supposed isoquinolone was in reality 2-homoveratryl, 5-veratryl oxazole; the correctness of the interpretation of Young and Robinson concern-



ing the mechanism of the reaction involved has been further acknowledged by Buck.⁵

The only instance of the preparation of oxazoles linked to the naphthalene ring recorded in literature is that regarding the synthesis of 2, α -naphthyl, 5-phenyl oxazole and 2-phenyl, 5- α -naphthyl oxazole by Lister and Robinson⁶ who obtained them by the action of conc. H_2SO_4 on α -naphthyl, ω -amino acetoveratrone and N-benzol, ω -amino, α -acetophenone respectively. The two naphthyl oxazole derivatives were feeble bases and exhibited fluorescence more intense than those of other oxazoles in solutions, a property which was supposed to be dependent on the long uninterrupted chains of conjugate double linkages connecting the aromatic nuclei through the oxazole ring.^{6,7}

We have carefully repeated the preparation of 2-phenyl 5- α -naphthyl oxazole using concentrated sulphuric acid as directed by Lister and Robinson as well as phosphorous oxychloride both with and without the addition of toluene as the cyclising agents. Although according to Lister and Robinson the cyclising agent of choice in the synthesis of 2-naphthyl, 5-phenyl oxazole is conc. H_2SO_4 , the cyclisation of N-benzil, ω -amino, α -acetophenone is best effected by employment of phosphoryl chloride. We have also studied the action of conc. H_2SO_4 on the amides III, V and VII. A solution of III in five parts of conc. H_2SO_4 , after heating at 100° for 5 minutes and dilution with ice-water gave in addition to resinous matter only a trace of basic matter which could not be characterised. The action of H_2SO_4 on the amides V and VII at room temperature was nil, the original amides being completely recoverable at the conclusion of the experiments. However, the action of sulphuric acid at 100° for 5 minutes on VII gave rise to a pale yellow solid separating from alcohol-acetic acid as a pale yellow crystalline powder exhibiting violet fluorescence in alcoholic or sulphuric acid solution and melting at 308-09° dec. The same product is also obtainable from VIII by similar action of H_2SO_4 . The substance appears to be acidic in character and has not yet been fully investigated.

Although it is usual to consider oxazoles as capable of breaking down to acids and amides on evaporation with hydrochloric acid and that oxidants and reducing agents frequently rupture the oxazole ring with great ease,⁸ the oxazoles derived from naphthalene should be considered as fairly stable. We had formerly reported¹ that oxidising agents such as alkaline hydrogen peroxide, dilute nitric acid and potassium permanganate in acetone solution had no action on the base VIII and that all the substances (II, IV, VI and VIII) then synthesised were resistant to reduction by the usual chemical methods. Some of the reducing agents used were zinc dust and sulphuric acid, amalgamated zinc and hydrochloric acid and tin and hydrochloric acid. The action of a few mineral acids on the above bodies has now been studied. The base IV by heating with con. HCl at 150-60° for 4 hours gave rise to intractable tarry matter, while simple refluxion with a mixture of acetic and hydrobromic acids for 5 hours resulted only in the

recovery of IV. The action of acetic acid-hydrobromic acid on VIII yielded an acidic principle, separating from alcohol in pale yellow needles, m.p. 193-95° after softening at 191° and exhibiting violet fluorescence in alcoholic solution. Hydrobromic acid had no action whatsoever on 2-phenyl, 5- α -naphthyl oxazole.

Although conclusive evidence by degradation studies is as yet unavailable, there can be no doubt that from their method of formation and properties of feeble basicity and intense violet fluorescence in neutral organic solvents,^{4,6,7,9,10} the substances hitherto considered to be benzoisquinolones possess in reality the naphthalenic oxazole structures. The names of the compounds II, IV, VI and VIII, viz., 1-methyl, 3:4-dihydro, 4-keto, 5:6-1-methyl, 3:4-dihydro, 4-keto, 7:8-, 1-methyl, 3:4-dihydro, 4-keto, 7-methoxy, 5:6- and 1-phenyl, 3:4-dihydro, 4-keto, 7-methoxy, 5:6-benzoisquinolines, therefore, should be corrected as 2-methyl, 5- α , naphthyl-, 2-methyl, 5- β , naphthyl-, 2-methyl, 5-(4', methoxy), naphthyl- and 2-phenyl, 5-(4', methoxy-) naphthyl oxazoles respectively.

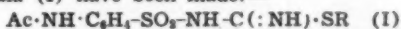
Presidency College,
Madras,
July 26, 1944.

B. B. DEY.
S. RAJAGOPALAN.

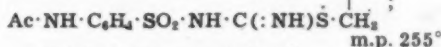
1. Dey and Rajagopalan, *Arch. Pharm.*, 1939, 217, 359; *Proc. Nat. Inst. Sci. India*, 1940, 6, 135.
2. Bischler and Napieralsky, *Ber.*, 1893, 26, 1903.
3. Buck, *J.A.C.S.*, 1930, 52, 3610.
4. Young and Robinson, *J.C.S.*, 1933, 275.
5. Buck, *Ibid.*, 1933, 740.
6. Lister and Robinson, *Ibid.*, 1912, 101, 1297.
7. Robinson, *Ibid.*, 1909, 95, 2167.
8. Richter's *Organic Chemistry*, 1923, 3, 113.
9. Foulds and Robinson, *J.C.S.*, 1913, 103, 1768.
10. Gabriel, *Ber.*, 1910, 43, 143, 1283.

N¹-SULPHANILYL-ISOTHIUREAS

IN continuation of the work already reported,¹ the following compounds of the general formula (I) have been made:—



1. $R = CH_2 \cdot CH_2 \cdot CH(CH_3)_2$; m.p. 186°
2. The free base, m.p. 145-46°
3. $R = CH_2 \cdot C_6H_5$; m.p. 173°
4. The free base, m.p. 143-46°
5. $R = CH_2 \cdot C_6H_4 \cdot NO_2(p)$; m.p. 214-25°
6. The free base, m.p. 153-55°
7. $R = CH_2 \cdot C_6H_4 \cdot OCH_3$; m.p. 138-40°
8. The free base, m.p. 89-92°
9. $Ac \cdot NH \cdot C_6H_4 \cdot SO_2 \cdot NH \cdot C : (NH) \cdot S \cdot CH_2$



10. The free base; m.p. 175-77°

The compound No. 1 was hydrolysed with 10 per cent. aqueous HCl, to get the corresponding free base No. 2, and compounds Nos. 3, 5, 7 and 9 were hydrolysed with alcoholic HCl to get the corresponding free bases.

The following sulphanilamide derivatives of N-aryl substituted pseudo-thioureas of the general formula (II) have been made:—

Ac NH·C₆H₄·SO₂·N R'·C(:NH)·SR" (II)

1. R' = Phenyl; R" = Ethyl; m.p. 209-10°
2. The free base; m.p. 192-93°
3. R' = Phenyl; R" = Propyl; m.p. 206-7°
4. The free base; m.p. 195-96°
5. R' = Phenyl; R" = Butyl; m.p. 207-8°
6. The free base; m.p. 191-92°
7. R' = Phenyl; R" = Allyl; m.p. 204°
8. The free base; m.p. 193-94°
9. R' = Phenyl; R" = Benzyl; m.p. 205-6°
10. The free base; m.p. 190°
11. R' = Phenyl; R" = *p*-nitro-benzyl; m.p. 201°
12. The free base; m.p. 166° (decomp.)
13. R' = *p*-tolyl; R" = Ethyl; m.p. 204-6°
14. The free base; m.p. 188-89°
15. R' = *p*-methoxy-phenyl; R" = ethyl; m.p. 200-1°
16. The free base; m.p. 194°
17. R' = β -naphthyl; R" = ethyl; m.p. 201-2°
18. The free base; m.p. 186-88°

These compounds await pharmacological examination.

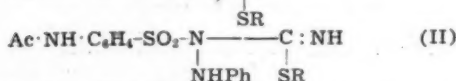
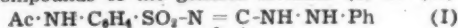
Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
August 9, 1944.

P. C. GUHA.
V. MAHADEVAN

1 *Curr. Sci.*, 1943, 12, 325.

SYNTHESIS OF SULPHANILAMIDE COMPOUNDS CONTAINING ALKYL-THIOL-1-SUBSTITUTED THIOSEMICARBAZIDES

In a previous communication¹ sulphanilamide compounds with thiosemicarbazide, and 4-phenyl-thiosemicarbazide have been described. Due to the pronounced basic character of the hydrazino group (-NH.NH.) in all these cases acetamino benzene sulphonylchloride reacted with the nitrogen in position 1. It seemed to be interesting to prepare sulphanilamido derivatives of 1-N-aryl thiosemicarbazides. There being no basic group like (NH.NH.) present in 1-substituted aryl-thiosemicarbazides they did not react with the sulphochloride. But 1-N-aryl-thiosemicarbazides reacted readily with alkyl halides to give the corresponding alkyl-thiol derivatives which reacted readily with acetaminophenylsulphochloride to give the compounds of the general formula (I) or (II).



1. R = Ethyl; m.p. 104-7°
2. R = Propyl; m.p. 91°
3. R = Butyl; m.p. 110°
4. R = Allyl; m.p. 83-6°
5. R = Benzyl; m.p. 62-7°
6. R = *p*-nitrobenzyl; m.p. 125°

Further work is in progress to elucidate as to whether the sulphanilamide compounds possess the structure (I) or (II).

The pharmacological studies of these compounds are in progress.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
August 9, 1944.

P. C. GUHA.
V. MAHADEVAN

1 *Curr. Sci.*, 1943, 12, 150.

STUDIES ON ANÆSTHETICS AND LOCAL ANÆSTHETICS

N-Substituted Amides and Esters of Nicotinic, Picolinic, and Iso-Nicotinic Acids

Of the three isomeric pyridine monocarboxylic acids, the β -variety, viz., nicotinic acid has, in recent years, assumed great importance as an accessory food factor belonging to the vitamin B complex¹ with great therapeutic possibilities. Further its diethylamide, familiarly known as 'Coramine', is a reputed cardio-respiratory stimulant.² A further point of interest in this acid is that its N-substituted ethanalamine and homologous esters have been shown to possess local anæsthetic activity.³

The present work, therefore, involves the preparation of the three isomeric acids from β - and γ -picolines isolated from the middle oil fraction of Indian coal-tar, and the α -acid from a sample of α -picoline. The β -acid was also prepared by the decarboxylation of quinolinic acid obtained by the oxidation of quinoline (i) isolated from Indian coal-tar, and (ii) synthesised by Sraup's method.

Though there is considerable literature on the oxidation of the picolines and quinoline, the available information was found to be very inadequate, and the detailed conditions for their convenient preparation had to be worked out using KMnO₄ solution at temperatures below 100° C., and isolation of the acids through the copper salts. Results of our experiments are given below:—

Raw material used	Acid obtained	Yield (% on theory)	M.P.	Equivalent
1. α -Picoline B.P. 124-29°	Picolinic acid	25	135-136°	123.4
2. Mixture of β & γ -picoline B.P. 140-47°	Nicotinic acid	11	225-226°	125.5
	Isonicotinic acid	12.5	305-306°	122.1
3. Quinoline B.P. 230-35°	Quinolinic acid	33	180° (decomp.)	83.0
4. Quinolinic acid	Nicotinic acid	80	232°	122.2

* Separated from the oxidation product by repeated crystallisation from absolute alcohol.

Coramine (b.p. 172-173°/19 mm.) has been prepared (yield, 68.8 per cent.) from nicotinic acid, via. its acid chloride, by the action of diethylamine also prepared in this laboratory.

From the acid chloride of the above pure mono acids, the following new *N*-substituted amides, which are likely to possess anæsthetic action, have been prepared.

- (1) Picolinic acid *p*-anisidide, m.p. 88°;
- (2) Picolinic acid *o*-anisidide, m.p. 110°;
- (3) Nicotinic acid *p*-anisidide, m.p. 141°;
- (4) Isonicotinic acid *p*-anisidide, m.p. 153°;
- (5) Picolinic acid benzyl amide (semi-solid).

β -Chlorethyl picolinate, $C_7H_7N \cdot CO_2 \cdot CH_2 \cdot CH_2 \cdot Cl$ (b.p. 136-138°/5-7 mm.) and β -chlorethyl nicotinate (b.p. 167-69°/45 mm.), have been prepared from the corresponding acid chlorides by the action of ethylene chlorhydrin. *p*-Methoxyphenylaminoethyl picolinate, $C_7H_7N \cdot COO \cdot CH_2 \cdot CH_2 \cdot NHC_6H_4 \cdot OCH_3$, was prepared from the chlorethyl ester by the action of *p*-anisidine; acetyl derivative, m.p. 170°. Further work on the preparation of some typical esters and amides of this series is in progress. The compounds prepared await pharmacological examination.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
August 9, 1944. P. C. GUHA.
R. KRISHNA MALLER.

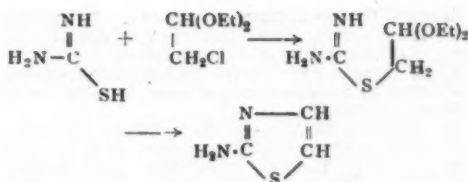
1. *Indian Med. Gaz.*, 1942, 77, 98. 2. *J. Amer. Pharm. Assoc.*, 1944, 33, 72. 3. *J. Amer. Chem. Soc.* 1942, 64, 1721.

N¹ AND N⁴ SUBSTITUTED SULPHANILAMIDES

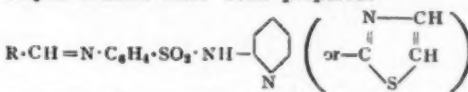
Part I. Schiff's Base of Sulpha-pyridine and Sulpha-thiazole

ALTHOUGH a number of Schiff's bases of sulphanilamide have been prepared and they have shown to be therapeutically active, no systematic investigation seems to have been undertaken on the preparation of Schiff's bases of the two well-reputed sulphanilamide drugs, viz., of sulpha-pyridine and sulpha-thiazole. The three anils of sulpha-pyridine¹ known so far have been prepared by the action of benzaldehyde, *p*-methoxy-benzaldehyde and cinnamic aldehyde, and they have been found to possess good therapeutic properties. No anil (Schiff's base) seem to have been prepared from sulpha-thiazole.

Aminothiazole to be used for the preparation of sulphathiazole required as the starting material for our work was prepared by the action of chloroacetal (prepared in this laboratory in satisfactory yield²) on thiourea. The method (English patent, E.P. 540,032, by the British Drug House, Ltd., by the action of brominated alcohol on thiourea; and the Indian Patent, 29,345, by the Director, Haffkine Institute, Bombay) by the action of chlorinated alcohol (in none of which details are given) came to our notice after the new method of preparation of aminothiazole was established in this laboratory. The reaction proceeds as follows:—



The following anils of sulpha-pyridine and sulpha-thiazole have been prepared:—



R	Melting point of anils of sulpha- pyridine	M.P. of anils of sulpha- thiazole
C_6H_5	240°	202°
$p\text{-OCH}_3 \cdot C_6H_4$	205°	160°
$3\text{-OH}, 4\text{-OCH}_3 \cdot C_6H_3$	146-47°	245°
3, 4, (OCH₃)₂ · C₆H₃	210°	138°
$C_6H_5 \cdot \text{CH} = \text{CH}$	210°	260°
C_6H_5O (furfuraldehyde)	214°	chars at 210°
$m\text{-NO}_2 \cdot C_6H_4$	254°	231°
$m\text{-Cl} \cdot C_6H_4$	101°	124°
$C_6H_5 \cdot \text{CH}_2$	decomposes at 100°	164°

Fuller details will be published elsewhere.

These compounds await pharmacological examination.

Work on the preparation of some more anils as also some acyl and sulphonyl derivatives, is in progress.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
August 9, 1944. P. C. GUHA.
K. R. DORASWAMI.

1. Kalloff, H. G., and Hunter, J. H., *J. Amer. Chem. Soc.*, 1940, 62, 158. 2. *vide Curr. Sci.*, 1943, 12, 82.

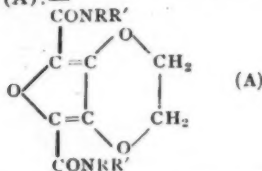
STUDIES ON ANÆSTHETICS AND LOCAL ANÆSTHETICS

Amides and Esters of 2:5-Dicarboxy-furo- (3:4)-*p*-dioxan

GILMAN¹ observed that β -diethylamino ethyl esters of acids containing aminobenzene, benzene, pyrrole, thiophene and furan rings possess low local anæsthetic action. Cook and Kreke,² from a comparison of the local anæsthetic actions as exhibited by the diethylamino ethyl esters of benzoic and furoic acids, showed that furoates are frequently somewhat superior. Degnan and Pope³ prepared large number of *N*-alkyl *N*-aryl furaminines, and made the interesting observation that *N*-*n*-butyl *N*-*p*-phenetylfuramidine hydrochloride is more than three times as active as cocaine, and it is not

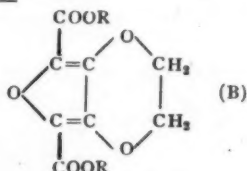
irritating to the cornea of the eye. It seemed very reasonable, therefore, that a search for new and efficient local anaesthetics in the differently (alkyl and aryl) substituted esters, amides and amidines might lead to some very interesting results.

2:5-Dicarboxy-furo-(3:4)-p-dioxan has been prepared starting from diglycollic acid by five steps.¹ This di-acid gave the acidchloride, m.p. 154°; yield 80 per cent. The di-acid chloride by reacting with varieties of aliphatic and aromatic amines have given the following diamides (A):—



- (1) R = H; R' = H; m.p. 333-35°
 (2) R = H; R' = Me; m.p. 260°
 (3) R = Et, R' = Et; m.p. 102°
 (4) R = H; R' = Ph; m.p. 103°
 (5) R = H; R' = p-methoxy-phenyl; m.p. 226°
 (6) R = H; R' = o-methoxy-phenyl; m.p. 339°
 (7) R = H; R' = o-tolyl; m.p. 322°
 (8) R = H; R' = p-tolyl; m.p. 257°
 (9) R = H; R' = m-tolyl; m.p. 271°
 (10) R = H; R' = benzyl; m.p. 86°
 (11) R = H; R' = C₆H₄·SO₂NH₂; 270° (decomp.)

The following four diesters (B) have been prepared:—



- (1) R = benzyl; m.p. 126°
 (2) R = CH₂·CH₂·N(C₂H₅)₂; m.p. 271°
 (3) R = CH₂—CH=CH·C₆H₅; m.p. 169-71°
 (4) Ethyl-thio-ester, m.p. 182°

Further work on the preparation of some more esters, amides and amidines of this series, as also on the preparation of esters, amides and amidines with the diacid chlorides of 2:5-dicarboxythieno-(3:4)-p-dioxan, and pyrro-(3:4)-dioxans is in progress.

The above compounds are under pharmacological examination.

Organic Chemistry Laboratories,
 Dept. of Pure & Applied Chemistry,
 Indian Institute of Science,
 Bangalore,
 August 9, 1944.

P. C. GUHA.
 A. H. MEHTA.

1. *J. Amer. Chem. Soc.*, 1925, **47**, 245. 2. *Ibid.*, 1940, **62**, 1951. 3. *Ibid.*, 1940, **62**, 1960. 4. *J. Indian Inst. Sci.*, 1938, **21A**, 115.

CHEMICAL NON-HOMOGENEITY IN CHROMITES AND ITS POSSIBLE USEFULNESS IN INDUSTRY

In the course of my investigations on the conversion of the Cr₂C₃ of chromite to chromate, I found that, in almost all experiments, the undecomposed portion of the chromite had a higher value for the ratio Cr/Fe than the chromite as a whole. This indicated that the chromite might not be chemically homogeneous and, to test this point, two samples of chrome ore were systematically investigated.

The ores had to be repeatedly fused with Na₂CO₃ and dissolved in sulphuric acid before they could be brought into complete solution. Eight such fusions were necessary in the case of one sample and seven in the case of the other. Even then small residues were left, which were rejected. The ores and the successive residues were mixed with their own weight of Na₂CO₃ and heated in a platinum crucible, kept slanting, with the lid on the crucible leaving a small opening, over the full flame of a Bunsen burner for two hours. I have repeatedly found that Na₂CO₃ fusion of chrome ore does not bring about complete solution of the ore at the first fusion or even after three or four fusions although strong heat is applied for a longer period. But this necessity for repeated fusion was an advantage in this investigation. The solution obtained after each fusion was separately analysed.

In Table I are given the percentages of Cr₂O₃ and Fe actually obtained, the percentage of Cr₂O₃ calculated as the percentage of the total Cr₂O₃, and the value of the Cr/Fe ratio for each solution. The samples are numbered 1764 and 1926. Total Cr₂O₃ per cent., total Fe per cent. and the value of the ratio Cr/Fe are respectively 49.60, 15.48 and 2.192 for 1764 and 48.29, 13.88 and 2.38 for 1926.

All the solutions of sample 1926 and only the last four solutions of 1764 were analysed for Al₂O₃ and MgO also, besides Cr₂O₃ and Fe. To make out the non-homogeneity more clearly, the sum of the compositions of solutions 2, 3 and 4, of 5, 6 and 7, and of all the six solutions of 1926, expressed in terms of the four molecules, MgO·Al₂O₃, MgO·Cr₂O₃, FeO, Cr₂O₃ and FeO·Fe₂O₃, and calculated to 100, are given in the bottom of Table II under columns 4, 5 and 6 respectively. The actual compositions in terms of the constituents Cr₂O₃, Al₂O₃, Fe₂O₃, Fe and MgO are also given in the top of the table. The composition of the first solution was not taken for calculation as it contained all the magnesium silicate mixed in the ore. In the case of 1764 the pure chromite mineral present in it was 80 per cent. of the ore. The mixed magnesium silicate was freed from it by heating with a mixture of HF and H₂SO₄ acids in which it dissolved. The percentages of Cr₂O₃, Al₂O₃, Fe and MgO present in this 80 per cent. of mineral were determined. The compositions of this, of the sum of the four solutions 5, 6, 7 and 8, and of the difference between these two are expressed and calculated in the same way as for 1926 and given in the bottom of Table II under

TABLE I

Solutions	1st	2nd	3rd	4th	5th	6th	7th	8th
<i>of 1764</i>								
1. Cr_2O_3 %	9.05	9.83	3.04	6.63	6.15	5.25	4.58	2.70
2. Fe %	6.55	3.31	1.27	1.46	1.08	0.82	0.68	0.36
3. Cr_2O_3 % calculated as above	18.25	19.82	7.94	13.37	12.40	10.58	9.23	5.44
4. Cr/Fe value	0.945	2.031	2.127	3.116	3.896	4.367	4.692	5.081
<i>of 1926</i>								
1. Cr_2O_3 %	11.20	9.40	5.15	5.06	6.09	3.56	6.64	
2. Fe %	5.01	3.51	1.34	1.29	1.11	0.59	1.06	
3. Cr_2O_3 % calculated as above	23.19	19.46	10.67	12.34	12.61	7.37	13.75	
4. Cr/Fe value	1.529	1.832	2.566	3.154	3.768	4.110	4.221	

TABLE II

Samples	1764			1926		
Columns	1	2	3	4	5	6
Composition of solutions of Table I	Composition of Col. 3 that of Col. 2	Solution Nos. 5, 6, 7 and 8	Composition in the mineral = 80% of ore	Solution Nos. 2, 3 and 4	Solution Nos. 5, 6 and 7	Solution Nos. 2, 3, 4, 5, 6 and 7
<i>In terms of the Constituents</i>						
Cr_2O_3	29.49	18.68	48.17	20.51	16.29	36.80
Al_2O_3	3.17	1.09	4.26	5.53	4.14	9.67
Fe_2O_3	3.25	2.89	6.14	3.01	2.37	5.37
FeO	12.65	1.19	13.84	5.19	1.43	6.62
MgO	2.80	5.44	8.24	5.47	5.75	11.22
Total (= % of ore)	51.36	29.29	80.65	39.71	29.98	69.68
Cr/Fe Value	1.687	4.347	2.192	2.272	4.014	2.815
<i>In terms of molecules and calculated to 100</i>						
$\text{MgO} \cdot \text{Al}_2\text{O}_3$	8.61	5.19	7.42	19.41	19.25	19.35
$\text{MgO} \cdot \text{Cr}_2\text{O}_3$	14.39	80.72	39.12	39.51	65.50	50.69
$\text{FeO} \cdot \text{Cr}_2\text{O}_3$	67.81	0.94	43.14	20.09	3.80	18.78
$\text{FeO} \cdot \text{Fe}_2\text{O}_3$	9.19	13.17	11.12	10.98	11.44	11.18

columns 3, 2 and 1 respectively. The actual compositions are also given as for 1926. FeO and Fe_2O_3 were not determined directly. The total Fe was divided between FeO and Fe_2O_3 so as to make the molecular proportions of $\text{MgO} + \text{FeO}$ equal to those of $\text{Cr}_2\text{O}_3 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$.

It is seen clearly that there is great difference in composition among the three portions belonging to the same chromite mineral and this clearly points to its chemical non-homogeneity.

Mysore Geological Department,
Bangalore, M. R. ANANTANARAYANA IYER.
March 11, 1944.

A DISEASE OF THE EQUISETUM (EQUISETUM DEBILE ROXB.) DUE TO FUSARIUM DIVERSISPORIUM SHERB.

The infected plants were collected from the canal bank at Harbanspura Rakh near Lahore by Mr. M. L. Seth. There is no reference to

any disease of Equisetum plants in India, though quite a number of diseases of Equisetum and several due to *Fusarium* sp., have been reported from other countries. Amongst the pathogenic *Fusaria* growing on Equisetum may be mentioned *Fusarium equiseti*, *F. avenaceum* and *F. bulbigenum*. *Fusarium equiseti* (Cda.) Sacc. (= *F. falcatum* App. et. Wr.) has been reported by Banerji¹ as causing a leaf-spot disease of *Eichhornia crassipes*.

The infected plants were in a semi-wilted condition. The lower internodes developed whitish linear spots, about a millimetre in length. These spots when examined were found to contain numerous long septate *Fusarium* spores. Hyphae collected below the epidermis. The spores germinated readily in hanging drops. Germ tubes are formed in 3-4 hours and are formed either from one or from both ends of the spores. These soon branch and become septate.

The fungus was first isolated by using acid media to keep down the bacteria. Later it was cultivated on potato glucose and Czapek's in

agar. In culture, the hyphae grew deep into the medium and also produced plenty of aerial mycelium. The aerial mycelium is at first white but later becomes pinkish when conidia are developed in great numbers. The aerial mycelium produces flesh-coloured sporodochia, the spores being 1-5 (mostly 3-5) septate, sickle-shaped, not foot-celled, with papillate base and a gentle tapering, often slightly beaked, apex. The septa are fairly distinct, spore sizes are as follows:—

Three septa—

$3.9 \times 23.2 (3.1 - 4.8 \times 18.1 - 30.1) \mu$.

Length:Breadth ratio = 6:1.

Five septa—

$4.3 \times 35.8 (3.6 - 4.8 \times 32.5 - 41.1) \mu$.

Length:Breadth ratio = 8:1.

The spores lack the needle-shaped form of *eupionnotes* and also lack *pionnotes*. As the culture becomes old, its rose colour changes and it becomes yellowish as *chlamydospores* are formed. These are double-walled, and do not germinate immediately. They are 7-15 μ in diameter.

The fungus matches up well with *Fusarium diversisporium* Sherb. and the author is grateful to Dr. G. Watts Padwick, the Imperial Mycologist, for matching the species and for verification of the measurements of the spores.

The pathogenicity of the fungus has been

established by inoculation experiments. Young plants growing in pots when sprayed with spore suspensions got readily infected.

Botany Department,
Panjab University,
Lahore,
August 3, 1944.

H. CHAUDHURI.

1. *J. Dep. Sc. Cal. Univ.*, Vol. I, No. 3.

FASCIATED AERIAL ROOTS OF BANYAN (*FICUS BENGALENSIS* LIN.)

FASCIATION which results in the formation of a flattened structure due to the fusion of a number of like parts has often been observed in stems and floral axis of plants. An interesting example of fasciated inflorescence of *Acrocarpus fraxinifolius* Wight has been reported by Dr. N. L. Bhor.¹ Various causes have been ascribed for the occurrence of this abnormality but it has rarely, if ever, been reported in the case of roots of plants. For this reason the present instance of fasciation observed in the aerial roots of *Banyan* is of considerable interest.

An examination of the fasciated roots showed that they were formed by a fusion of more than one closely developing lateral roots. In

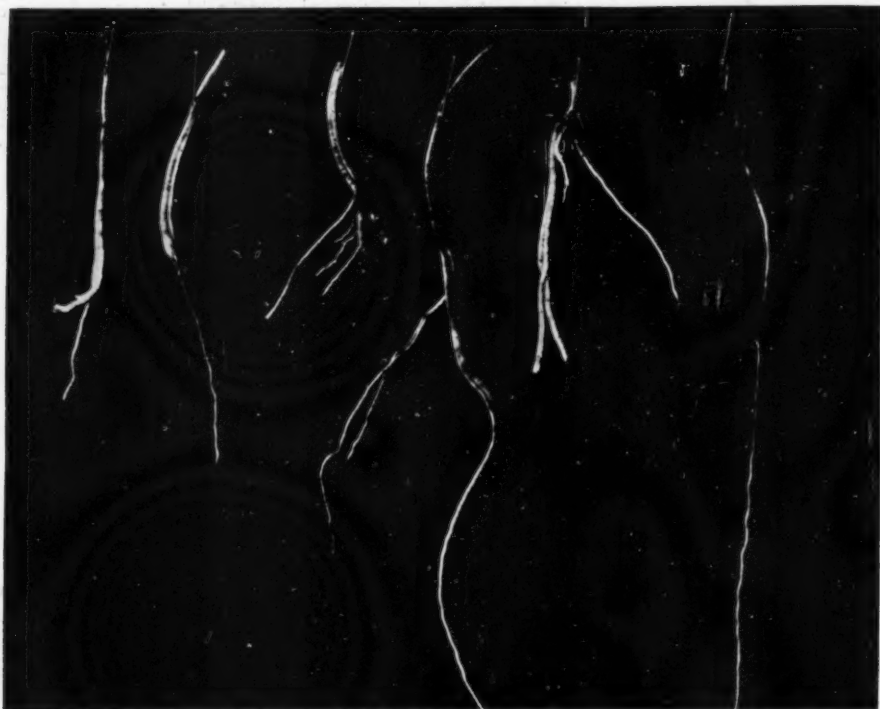


FIG. 1. The root at extreme right shows normal development consisting of a single cylindrical structure. To the left are examples in which two or more roots have become fused and show flattening.



FIG. 2. The root at the extreme right shows normal development of a group of roots at the lower end of an old root. These in turn have still younger roots at their lower extremity. The newly formed young roots are white in colour and the older roots are of darker shade. On the left are examples showing different degrees of fasciation. The second and 3rd from left are examples of extreme cases in which the structure cannot be easily recognised as root.

Fig. 2 is shown a series of fasciated roots in which the number of roots that have become fused to form the flattened structure progressively increases. In some due to unequal development of the roots so fused the entire structure has become twisted and curved (Fig. 2, second and third from left).

The fasciated aerial roots were observed on a number of *Banyan* trees growing on one of the sides of an avenue. A careful observation showed that on some trees even more extreme forms of fasciation than the ones illustrated in Fig. 2 were found to a considerable extent. On others fasciation was found to a much less extent and that too of a less complicated type as shown in Fig. 1. On some of the fasciated roots it was observed that normal roots were developing while in others fasciated roots produced fasciated ones. Along the same avenue the remaining trees were observed to produce only normal aerial roots and not a single fasciated root was found on them. Since the fasciated roots give rise to normal roots and vice versa it may be surmised that fascia-

tion in aerial roots of *Banyan* is the result of some factor other than genetic.

College of Agriculture,
Poona,
June 16, 1944.

L. S. S. KUMAR.

1. *Journal of the Bombay Natural History Society*,
April 1942, 43, No. 1, pp. 113-14.

POLARITY IN VACUOLATING DIVIDING CELLS IN *POLYGONUM ORIENTALE* L.

ATTENTION to this aspect of cell division was perhaps drawn for the first time in a more definite and clear manner by Sinnott and Bloch in 1941.¹ As a result of their studies in a wide range of vascular plants they came to the conclusion that wall formation in these cells is determined in early prophase by the position of the phragmosome, a more or less

continuous diaphragm formed by the aggregation of cytoplasmic strands holding the nucleus in suspension in the dividing cell (Fig. 3c). Thus long before the wall is laid down its position is determined by the position taken

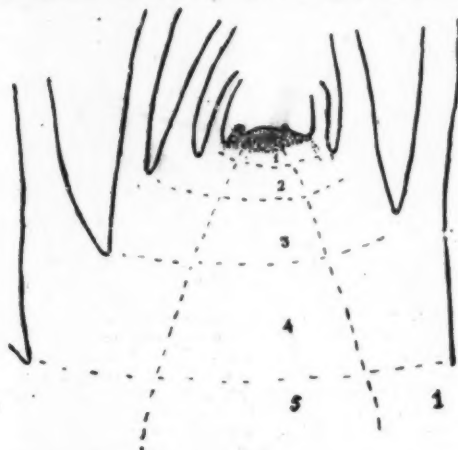


FIG. 1.—Longitudinal section of the growing apex showing the position of the apical meristem and the relative elongation of the internodes.

by the phragmosome. They said that "the first visible evidence of polarity of the cells is thus provided by the cytoplasmic configuration rather than by events in the nucleus" (p. 232).

During my anatomical studies on the shoot-apex organization in *Polygonum orientale* I have come across stages in the division of pith cells in the rapidly elongating internodes which are exactly similar to the stages given in Fig. 3 by Sinnott and Bloch.²

It appears that Sinnott and Bloch studied their materials in microtome preparations, but in addition to microtome preparations I have studied them in macerated material with very encouraging results. As direct maceration in 5 per cent. chromic acid caused heavy contraction of the protoplasm the shoot-apex was previously fixed in FAA solution before being macerated in 5 per cent. chromic acid. This pre-treatment caused much less contraction of the protoplasm than in the previous case. For examination at a later period the macerated material after being thoroughly washed in running water, was preserved in 30 per cent. alcohol.

Pith cells from the macerated apex were carefully separated out, stained in 1 per cent. aqueous eosin, 1 per cent. safranin solution and in Delafields hæmatoxylin, tried separately, and examined in 20 per cent. glycerine solution. A little pressure on the cover-slip causes the pith cells to separate in beautiful longitudinal files (Fig. 2).

Fig. 1, which is drawn from a microtome preparation, shows the distribution of the apical meristem and the relative elongation of the internodes (1-4) in the apical bud at the stage

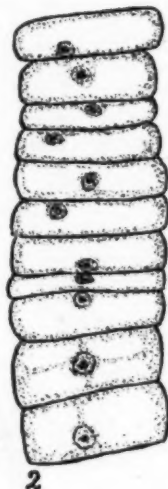


FIG. 2.—A file of vacuolating, dividing and expanding pith cells from the 4th. and 5th. internodes (macerated material). $\times 830$.



FIG. 3.—a-f, showing the cells in division; position of phragmosome in c, determining the plane of the future cell wall, d-f. $\times 830$.

when the section was cut. The apical meristem consists of a 3-layered *tunica*, and a central group of initials, the *corpus*; though the *flank* meristem is present the *rib* or *file* meristem of Schüpp and Priestley is absent. In the first and second internodes from the apex the division of the cells derived from the corpus and which ultimately would have given rise to the pith in the permanent region, are characterised by irregular divisions and the resulting cells though vacuolating and dividing, are not arranged in longitudinal series or files. In the third internode, near the base, the vacuolating dividing cells tend to assume a file organization, and in the fourth and fifth internodes, which are very rapidly elongating, these cells are fully organised in files, and their division now takes place exclusively by transverse walls. The pith cells of the fourth and fifth internodes form the ideal material for a study of the polarity of these cells. Fig. 2 shows an isolated file of the vacuolating and expanding pith cells from macerated material.

In Fig. 3 are given camera lucida drawings

of a few salient stages in the division of these cells. They are essentially the same as given by Sinnott and Bloch in their Fig. 3 (p. 227).

The results of the study of my material confirm the phragmosome theory of cell division in vacuolate plant cells as formulated by Sinnott and Bloch.¹

Department of Botany,
Presidency College,
Calcutta,
May 11, 1944.

GOPAL CH. MITRA.

1. Sinnott, E. W. and R. Bloch, "Division in vacuolate plant cells," *Amer. Jour. Bot.*, 28: 225-232. 2. —, "The relative position of the cell walls in developing plant tissues," *Ibid.*, pp. 607-17 (for complete literature).

DUCTUS CAROTICUS IN THE PIGEON

IN a pigeon dissected in the class in February 1944, I came across an abnormality in the arterial system due to the presence of the *Ductus caroticus*. A similar variation has just been observed in the Presidency College, Madras, and recorded in *Current Science*.¹ The only other record of such a variation which I could come across is one from Calcutta.² Since such variations are rather rare in the pigeon I give below a sketch of the dissection of the chief arterial vessels in this Trivandrum specimen.

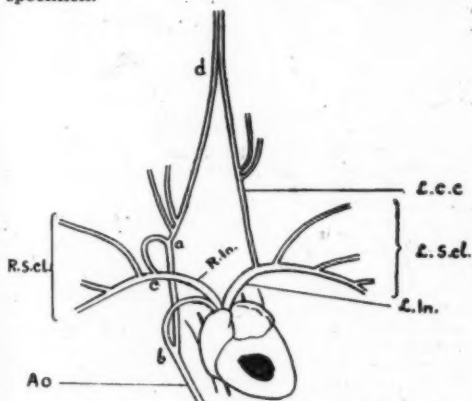


FIG. 1.—Ventral view of the arterial arches of the Trivandrum specimen referred to in the Text.

There can be no doubt that this variation represents the persistence of certain embryonic conditions which did not change while the other parts of the circulatory system changed to the adult arrangement. The part of the embryonic lateral dorsal aorta on the right side, between the third arch (Carotid) and the fourth arch (Systemic) has persisted as it does normally in *Sphenodon* and some of the lizards among the Reptilia and in the Apoda and some of the Urodela of the Amphibians. On the left side with the complete disappearance of the Systemic arch the corresponding

part of the dorsal aorta on that side has completely disappeared.

It is interesting that this connection was quite as broad and full of blood as the basal part of the Carotid. The Carotid itself, while sufficiently broad at the base, became slightly narrower just beyond this connection but further beyond it got normal in size comparing with the Carotid of the other side. Judging from the figures of the other specimens it would appear that in them too, it was an open connection with clear blood flow.

Lillie³ suggests as one of the causes for the disappearance of this part of the dorsal aorta in normal development, the reduction of the blood flow in it as the developing Carotid arch would draw off a forward current of blood and the Systemic would drain off backwards with little chance of blood flowing through this connecting part. A glance at the figure given here and the figure of the Presidency College specimen¹ would easily suggest a probable cause that has brought about the persistence of this part in these specimens: for here we find that the base of the Carotid has got bent downwards more or less, resulting in a flow of blood through this connecting region. This is not so well marked in the Calcutta specimen but still, even here there is a slight bend at the junction of the Carotid and the ductus.

Interpreting the Presidency College specimen Miss Subhapradha¹ looks upon the entire region from the Innominate to the aortic arch (c a b, Fig. 2 C) as the *Ductus caroticus*. As a result of this assumption she is faced with certain conclusions which as she "correctly remarks are inexplicable embryologically. For instance, on this view it would appear that the *Ductus caroticus* connects the Innominate (or Subclavian) with the aorta and that the Carotid arises from the *Ductus caroticus*!

From a study of the three specimens I suggest another view which makes this anatomical peculiarity easily understood in the light of embryological development. To elucidate this I am giving diagrams of the arteries of the three specimens. The part of the *Ductus*



FIG. 2.—Diagrams of the three abnormal specimens recorded.

- A—as in the Calcutta specimen.
- B—as in the Trivandrum specimen.
- C—as in the Madras specimen.

Ao, Aortic arch. ab, *Ductus caroticus*. ca, Basal part of the Right Common carotid. d, The Carotid. L.C.C., Left Common Carotid. L.In., Left Innominate. R.In., Right Innominate. L.Scl., Left Subclavian. R.Scl., Right Subclavian.

caroticus from the Innominate to the point of origin of the right Common Carotid. (ca) forms really the basal part of the Carotid itself, i.e., the basal part of the Carotid has been bent backwards probably due to the backward pull by the contracting ductus. The remaining part alone (ab) which is rather short in the Presidency College specimen, connecting the Carotid with the aortic arch is the Ductus caroticus. This view brings these three abnormal specimens in the same category with varying degrees of contraction of the Ductus caroticus and explains the conditions in full accordance with embryological development. The Calcutta specimen would seem to represent the simplest condition with a typical Ductus caroticus (A, a b). The Trivandrum specimen would come next where the Ductus caroticus has contracted to a certain extent pulling the Carotid at its junction with the ductus slightly downwards (B, a b). In the Presidency College specimen which represents the extreme stage, (C, a b) the ductus has contracted considerably and the Carotid is pulled backwards from its very origin from the Innominate, so as to bring the ductus and the base of the Carotid in a line. This apparent connection (C, cab) between the Innominate and the aorta is easily mistaken for the Ductus caroticus and the Carotid would then appear to arise from this connection! The backward displacement of the Vertebral and the oesophageal arteries on the right side is evidently the result of the pulling backward of the base of the Carotid due to the contraction of the Ductus caroticus.

This study also suggests that during the transition of the arteries from the embryonic to the adult condition one of the mechanical forces at work in bringing about atrophy of the unnecessary vessels is contraction, side by side with constriction. Under normal conditions where the connection becomes practically bloodless contraction would have only the effect of aggravating the constriction: but in these abnormal cases where the connection has full blood flow and grows side by side with the other parts of the circulatory system, contraction would pull the base of the Carotid backwards.

Zoology Laboratory,
University College,
Trivandrum,
June 1944.

A. P. MATHEW.

1. *Chir. Sci.*, April, 1944. 2. *Anat. Anz. Bd.*, 1938, 80, No. 7/10, 178. 3. Lillie, F. R., "The Development of the chick," 1919, 361.

ON THE BIONOMICS OF THE *LEIOGNATHIDAE**

SPECIES of *Leiognathus* and *Gazza*, popularly known as the Silver-Bellies, contribute to one of the important fisheries in the shallow sea around Pamban and Rameswaram from September of one year to May of the next year.

One thousand and one hundred and seventy specimens ranging in size from 4 to 16 cm.

were examined in the laboratory of Krusadai Biological Station during the years 1941, 1942 and 1943. The following is the composition of the different species constituting the catches: *Leiognathus bindus* 40 per cent.; *L. equulus* 15 per cent.; *L. duara* 10 per cent.; *L. rucconius* 8 per cent.; *L. brevirostris* 4 per cent.; *L. insidiator* 3 per cent.; and *Gazza minuta* 20 per cent.

Food.—The diet consists entirely of plankton; but *Gazza minuta* occasionally feeds on fingerlings of the White-Bait (*Stolephorus* sp.). The following is the analysis of the planktonic food:—

Phytoplankton: (1) *Coscinodiscus*, (2) *Rhizosolenia*, (3) *Nitzschia*, (4) *Thalassiothrix*, (5) *Fragilaria*, (6) *Pleurosigma*, (7) *Biddulphia*, (8) *Detonula*, and (9) algal filaments.

Zooplankton: (1) Copepods, (2) *Rhopalophthalmus egregius*, (3) *Leucifer hansenii*, (4) Crustacean eggs, (5) *Megalopa* larvae, (6) Ostracods, (7) Larval bivalves, (8) *Spiratella* spp., (9) Foraminifers, (10) *Ceratum* spp., and (11) Fish eggs of *Stolephorus* sp.

Spawning Season.—There are two spawning seasons, namely, November & December, and April & May.

Enemies.—Silver-Bellies form the natural food of the following carnivorous fishes: (1) the Black-finned Shark, *Carcharias melanopterus*, (2) the Seer, *Scomberomorus commersonii*, (3) the Jew-fishes, *Sciaenaglaucis* and *Otolithus ruber*, (4) the Ribbon Fish, *Trichiurus savala*, (5) the Horse Mackerel, *Caranx sanson*, (6) the Big-jawed Jumper, *Lactarius lactarius*, and (7) the Barracuda, *Sphyræna obtusata*.

Food Value.—The Silver-Bellies contain fine bones, and the flesh is scanty. Yet they are esteemed both in the fresh and sun-dried condition, the latter being considered as more palatable. The dried Silver-Bellies are of medicinal value, it being given to convalescents in general and to patients suffering from Malaria in particular.

Fisheries Section,
Dept. of Industries &
Commerce, Madras,
July 4, 1944.

P. I. CHACKO.

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FOOD OF THE INDIAN MACKEREL (*RASTRELLIGER KANAGURTA* RUSSELL) OF THE WEST COAST OF MADRAS PRESIDENCY¹

"UPON the abundance of mackerel depends the welfare of many thousands of the citizens of Massachusetts and Maine." So observed Prof. Goode on the American mackerel fishery. So is the case with the mackerel of the West Coast of the Madras Presidency. The Indian mackerel (*Rastrelliger kanagurta* Russell) constitutes one of the important food fishes of the Malabar Coast.

A remarkable uniformity has been observed in the food of different species of mackerels in the different seas regarding the selection of food organisms at certain seasons of the year. So much has been observed on the uniformity of diet that the English mackerel fishermen take the colour of the water as an indication of the fishery. The colouration of the water is due to the abundance of certain types of planktonic organisms, just like the 'red water' of the Malabar Coast caused by the abundance of *Noctiluca* and *Peridinium*, the green water by *Trichodesmium*, *Coscinodiscus*, etc. The formula of E. J. Allan regarding the relation between the good catch of mackerel and a rich development of plankton consequent upon the sunshine has got a similar bearing on the mackerel fishery of our coast.

The food of mackerel, as revealed by the examination of stomach contents are soft and semi-solid in consistency but in a few cases granular. It will be of interest to know about the colour of the stomach contents. In the absence of any colour standard it will be premature to draw any specific conclusions regarding the colour produced by the presence of certain organisms and yet the presence of the following organisms is attributed to the different shades of colour of the contents in mackerel in a general way.

Light green: Dinoflagellates; Copepods; Infusorians.

Dark green: Dinoflagellates; Infusorians.

Greenish yellow: Dinoflagellates; Copepods; Diatoms.

Dark yellowish brown: Dinoflagellates; Diatoms; Copepods (in smaller numbers); Infusorians (in smaller numbers).

Dark greenish brown: Diatom; Infusorians; Copepods.

From the analysis it seems that the Dinoflagellates give the green colour, Diatoms yellowish tinge, and Copepods brownish tinge and the combination of these three in various proportions result in the various shades of the food contents.

The following organisms constitute the regular diet of the Indian mackerel (*Rastrelliger kanagurta* Russell):—

Phyto-plankton—

- (1) *Coscinodiscus*: *C. jonesianus*; *C. oculinisidis*; *C. gigas*; *C. joneschii*. (2) *Peridinium*: *P. depressum*; *P. ovatum*. (3) *Fragillaria*. (4) *Ceratium*: *C. tripos*; *C. massiliense*. (5) *Thalassiothrix nitzschoides*. (6) *Nitzschia* sp. (7) *Asterionella japonica*. (8) *Trichodesmium* sp. (9) *Rhizosolenia*. (10) *Pleurosigma*. (11) *Biddulphia*. (12) *Planktoniella*. (13) *Dinophysis homunculus*. (14) *Tintinnus*. (15) *Chaetoceras*. (16) *Ditylum*. (17) *Planktoniella*.

Zoo-plankton—

- (1) Copepods: *Paracalanus* sp.; *Euterpina* sp.; *Acartia* sp.; *Oithona* sp.; *Temora* sp. (2) *Evadne*. (3) *Leucifer*. (4) *Daphnia*. (5) Larval crustaceans. (6) Larval bivalves. (7) *Limacina* (a pelagic shell fish). (8) *Pteropods*. (9) Fish-eggs—(i) *Stolephorus* sp. (ii) Fish-scales. (iii) Bristle-worms.

Copepods.—The copepods along with larval crustaceans form the staple diet and constitute the bulk of its food. It is, therefore, supposed that mackerel closely follow the copepods, the abundance or paucity of which in the fishing zone may lead to a good or a poor fishery.

Fish-eggs.—Mackerel consumes regularly fish-eggs of the horse-mackerel, the Anchovy and the white bait. This feeding on fish-eggs may effect the fisheries of the fishes whose eggs the mackerel feed on.

Fish-scales.—Fish-scales have been found commonly included in the stomach contents of adult mackerel. Perhaps the fish supplements its planktonic diet by occasionally feeding on dead fish, as the adult has not been found to prey upon live-fish, unlike its European or American ally.

Stolephorus.—The inclusion of white-bait in stomach contents of young mackerel examined on a few occasions indicate the carnivorous habit of the young, while the adults are not.

Trichodesmium is said to fatten the mackerel and consequently it is believed that the taste of mackerel improves when this diatom occurs in large patches during March and April. This has been noticed in good quantities in the food of mackerel, during the month. The incidence of mortality of fishes by this alga is more due to the asphyxiation caused by the dead decaying diatoms.²

The presence of these planktonic organisms in the sea in large numbers explains the abundance of the plankton-feeding fishes like mackerel and oil sardine. These animal organisms, copepods, depend upon the diatoms which in turn rely on the amount of "indispensable food substances" present in the sea and brought by the floods, rains and sunshine. Naturally it leads one to expect to forecast a good or bad fishery with the amount of rainfall, the quantity of nitrates, silicates and phosphates brought down into the sea and the amount of strong sunlight, besides various local ecological factors.

West Hill,
June 23, 1944.

K. CHIDHAMBARAM.

1. Part of the work of the Fisheries Biological Station, West Hill.

With the kind permission of the Director of Industries and Commerce, Madras.

2. A separate note on this is being written.

REVIEWS

Clouds and Weather Phenomena. By C. J. P. Cave M.A. (Cambridge University Press), 1943. Pp. 1-22 and 42 illustrations. Price 5s. net.

The text of this little book besides acquainting the uninstructed reader with the natures and names of the various clouds that dapple or blot the sky, also gives accounts and explanations of sunset, moon's changes, rainbows, the mirage, haloes, coronae, broken spectres and condensation trails of high-flying planes. The 42 illustrations accompanying the book and illustrating the text are exceedingly good. This book was originally issued in 1926 and went through several reprints. This new edition, however, quite supersedes the old. The reading matter has been revised, augmented and re-set. The illustrations have newly been made, many of them from fresh photographs. The book may be warmly commended to every one who is interested in the weather and who is not?

C. V. RAMAN.

Solvents. By Thos. H. Durram. (Monographs on Applied Chemistry Series.) Fifth Edition. (Chapman & Hall), 1944. Pp. xii + 202. Price 17/6.

In the revised and enlarged fifth edition, the author has striven to widen the utility of this well-known book, originally written to facilitate the intelligent use of solvents in the cellulose-lacquer industries. The general form of the book remains same as in previous editions, the book being divided into two parts, the first dealing with the scientific fundamentals underlying the choice of a solvent, and consisting of eight chapters devoted to a broad discussion of Solvent action, Solvent power and dilution ratios, Plasticising solvents and their functions, Solvent balance and determination of solvent compositions, Viscosity, Vapour pressure and evaporation rate, Inflammability and Toxicity. The causes underlying "cotton bluish", "gum bluish", "chilling", etc., are discussed lucidly. The reviewer refrains from cavilling at the redundancies in some of the physico-chemical explanations such as given on p. 31 for rates of evaporation, since the essential purpose of this part of the book to give an intelligent interpretation to the prevailing technical "practices" in the cellulose-lacquer industries is, in the main, well served.

The second part of the book consists of nine chapters dealing somewhat comprehensively with the individual solvents grouped into Hydrocarbons and sundry solvents and Nitro-paraffins, Alcohols and their ethers, Ketones, Esters, Glycols and their ethers, Cyclohexane derivatives, Chloro compounds, Furfurals, and Plasticising solvents. Where specifications of an official nature are prescribed, they are presented in a convenient abbreviated form for quick reference.

A list of Trade names and probable compositions, Solubility tables and a Plasticiser

dosage table form three useful appendices to this well-written and neatly got-up monograph.

M. A. G. RAU.

Porcelain and Other Ceramic Insulating Materials, Vol I. By Dr. Ing. Ernst Rosenthal. (Chapman & Hall, Ltd., London), 1944. Pp. xii + 287 with 97 figures. Price 28 \$ net.

Dr. Rosenthal is too well known in the field of ceramics to need any introduction to those interested in the subject. He was for many years the Technical Director of one of the largest porcelain organisations in Europe. His contribution to the development of the ceramic industry in general, and electro-porcelain in particular, are of the highest value. In view of the scarcity of literature on the subject (especially in English) and its importance in electrical engineering the book is most welcome and opportune.

The book gives a comprehensive survey of the entire field of electro-porcelain, its manufacture, characteristics and uses.

The book is divided into ten chapters.

The first four chapters are devoted to a general description of the structure and characteristics of electro-porcelain and other ceramic materials, such as those used for spark plugs, and how the manufacturing processes influence them. Reference is also made to the more important developments in the design of porcelain insulators and to the specifications adopted in different countries, especially the U.S.A. and Germany.

Chapters V, VI and VII deal with the raw materials used in the manufacture of porcelain, and the methods of testing them. In addition to the usual chemical and mechanical tests, the recently developed microscopic and X-ray analyses of raw materials and fired bodies are also briefly described. The latter tests are much more important for the manufacture of electro-porcelain than for other branches of ceramic industry.

The manufacture of porcelain is taken up in great detail in Chapter VIII. After describing the various processes and machinery involved during the several stages of manufacture, such as preparation of the body and glazes, shaping, drying, and firing, the latest developments in machinery, furnaces, and also the differences in manufacturing methods in various countries, are discussed. Special mention might perhaps be made of two features, viz., (1) The Development of infra-red drying (in U.S.A.)—it is claimed that this gives appreciable saving in time and labour; and (2) The Development of new types of "Globar" elements without water-cooled terminals (for use in Electric tunnel kilns). This feature would materially bring down the cost of furnace operation.

The last two chapters deal with the various new ceramic materials developed in recent years for high frequency purposes such as those used for the manufacture of coil formers,

bases of trimmer condensers, valve and crystal holders, wave-range switches, variable inductances, high frequency condensers, etc.

The book is profusely illustrated and the printing and get-up are excellent, considering that it is a war-time publication.

The book will be found invaluable both to the ceramist who is interested in the manufacture of electro-porcelain and the electrical engineer interested in using it.

The second volume dealing in greater detail with the application of ceramic materials to the electrical industry is eagerly awaited.

H. N. RAMACHANDRA RAO.

An Isovol Map of the South Wales Coalfield.
Department of Scientific and Industrial Research: Fuel Research: Physical and Chemical Survey of the National Coal Resources No. 56. (H. M. Stationery Office, London), 1944. Isovol Map, price 1s. 3d.; descriptive pamphlet, price 6d.

This is the second of a series of papers in which data on the South Wales Coalfield are being published. The first (No. 55) dealt with the characters of the seams and showed in what directions changes in composition and ranks of coal took place. The paper (and map) under review shows particularly the change in the volatile content of the seams from place to place and the isovol lines deduced therefrom.

The paper accompanying the map describes how the data were collected and plotted and also discusses the relationship of the volatile matter to certain other properties such as carbon content, caking property and heating (calorific) value. The isovol map prepared in this manner is useful in respect of the ordinary bituminous coals but not anthracites. The latter contain only a small amount of volatiles but the percentage of hydrogen in the coal substance forms a good basis of classification. Certain simplifications have been adopted to get over difficulties connected with irregularities of the coal seams as the map would otherwise be unnecessarily complicated, and as perhaps several of the seams would then require individual treatment. The map and the ex-

planatory text are complementary to each other and represent the result of study of much detailed information available on this important British Coalfield.

The work of Institutions like the Fuel Research Board, under whose auspices this has been issued, is a constant reminder to us in India of our colossal ignorance of the detailed properties of the materials which constitute our natural resources.

M. S. K.

Polynesians—Explorers of the Pacific. By J. E. Weckler, Jr. (Smithsonian Institution War Background Studies, No. 6, Washington), 1943.

Long before the days of Columbus and the Vikings, Polynesian sailors in their double-hulled ships fashioned with stone tools explored the vast stretch of the sea extending from their original home near the Asiatic mainland to New Zealand, Hawaii and Easter Island, and possibly also they reached Peru. In this clear summary of the work of the leading ethnologists on Polynesian history and sociology, Mr. Weckler gives the public who are now specially interested in these islands because of their importance as theatres of war, an extremely readable account of the story of the Polynesian voyages of discovery as preserved in their myths and folk-lore. He also gives conclusive proofs to show that the voyages were well-planned and purposeful. The deleterious effects on the Polynesians of the early contact with European adventurers and the missionaries, and the manner in which the natives of Hawaii, New Zealand and Tonga are now reintegrating their lost cultures are described with great sympathy in the concluding pages of the pamphlet. An alien rule is a continuous source of irritation to the Polynesians and Mr. Weckler's plea in this connection, addressed to his fellow Americans, is this: "The most fundamental freedom of all is the right to self-government. To be consistent with our ideals and to prove our sincerity to the world, we should prepare to give this privilege first of all to the disenfranchised peoples who are now under our dominion."

A. ATYAPPAN.

SCIENCE NOTES AND NEWS

The Ceylon Association of Science was formally inaugurated on the 29th July 1944 at a meeting of scientists held at the University of Ceylon. The Association is designed closely on the lines of the British Association for Advancement of Science, and the Indian Science Congress. As in the case of these other bodies the objects of the Ceylon Association of Science are the advancement of pure and applied science in the Island, holding of an Annual Session, and dissemination of scientific knowledge. Membership of the Association consists of three classes, viz., Foundation Members, Sessional Members and Student Members.

Mr. D. N. Wadia, Ceylon Government Mineralogist and former President of the Indian Science Congress, was elected General President of the Association, and Dr. V. Gabriel, Senior Surgeon, General Hospital, Colombo, was elected the President-elect.

For the purpose of discussion at the Annual Session the following sections have been formed:—(1) Medical and Veterinary Sciences—President: Prof. W. A. E. Karunaratne; (2) Agriculture—President: Dr. R. V. Norris; (3) Engineering—President: Prof. R. H. Paul; (4) Natural Sciences—President: Very Rev. Fr. M. J. Le Goc; Physical Sciences: Prof. A.

Kandiah. Office-bearers for another section which includes Psychology, Social Sciences and Education have not yet been elected.

It is proposed to hold the first Session of the Association as early as possible in the coming year.

To encourage scientists to devote special attention to problems of colonial interest, a number of Colonial Research Fellowships have been instituted by the Secretary of State for Colonies. It is hoped that these would constitute the means of creating a cadre of scientists with special knowledge of environmental and social issues of the Colonies and that research on fundamental problems in tropical regions will be encouraged. These Fellowships will normally be for two years, but may be extended for a year and are tenable in any part of the British Colonial Empire. They are open to graduates under 35 years of age from any part of the British Commonwealth and the Empire and will carry an allowance of £400 to £600 per year. Provision has been made for 25 such fellowships within the next five years. The award of these Fellowships will be made by the Secretary of State for Colonies on the advice of the Colonial Research Committee.

With a view to train specialists in diplomacy and foreign trade, the Moscow University has created a new course in International Relations. It is a five-year course and students are expected to specialise in detailed study of history, tradition and contemporary conditions of individual States.

A scheme for starting a Medical College in the Benares Hindu University is understood to have been prepared. The scheme will be submitted to the Gwyer Committee for approval and thereafter the Government will be moved for permission.

The thirteenth annual convention of Sugar Technologists' Association of India will be held in Cawnpore on September 16 and 17 in collaboration with the annual general meeting of the Indian Sugar Mills Association of Calcutta. Scientific papers dealing with original research and some other problems connected with the sugar industry will be discussed at the convention.

Short notes on Industrial Topics, both technical and of news value, are invited on payment basis for publication in the "Technical Research Notes" and "Notes and News" sections of the Industrial and News Edition of the *Journal of the Indian Chemical Society*. For each note approved for publication Rs. 2 will be paid. None of the notes, approved or unapproved, will be returned unless accompanied with requisite postage stamp. Further information can be had from the Hon. Secretary, Indian Chemical Society, P.O. Box 10857, Calcutta.

At the seventh meeting of the Governing Body of the Council of Scientific and Industrial

Research held in New Delhi on August 1, 1944, it was decided that the Silicate and Glass Research Institute should be located at Calcutta and that its construction and equipment should be taken in hand forthwith. A sum of Rs. 14,000 was sanctioned to meet the cost of nucleus staff for the Institute for the current financial year. Two scholarships for foreign study of glass and porcelain subjects were also sanctioned. The Governing Body expressed their grateful thanks to Dr. Sir U. N. Brahmachari, Mr. I. D. Varshney (President, U.P. Glass Manufacturers' Association), and the Bengal Glass Manufacturers' Association, for the donation of Rs. 10,000 that each one had made towards the cost of the Institute. The question of the selection of a site for the National Physical Laboratories was discussed. The final decision was left over until the matter had again been examined by the National Physical Laboratories Committee. The Governing Body recorded their appreciation of the generous gift of 100 acres of land made by the Raja of Jharia for the construction of the Fuel Research Station at Dhanbad. A post of an Assistant Director of Planning for the purpose was sanctioned. The Governing Body noted with interest the progress made with regard to other two research institutes, i.e., National Chemical Laboratories and National Metallurgical Institute.

A sum of about one lakh of rupees was sanctioned for research on the following new schemes: manufacture of resistance alloys; preparation of alkali and water-soluble ethyl cellulose; investigation on essential oils of C.P. and Berar; manufacture of graphite crucibles "Ferrous"; study of conditions favouring the increase of alcohol concentrations in the fermented distillery wash from the present average of 7 per cent. to 10 per cent. or 12 per cent. by volume; manufacture of Aluminium titanium alloys; manufacture of porcelain containers for hydrogen peroxide; pilot plant experiments on the manufacture of sodium and magnesium metals by electrochemical methods; scheme for the setting up of medium voltage positive ray discharge tube for the investigation of nuclear disintegration; development of air-driven ultra centrifuge for physical, chemical and biological work; and investigation on electrical properties of some typical order, disorder alloys, particularly in the neighbourhood of their Curie temperatures and on the influence of quenching on these properties.

The Health Survey and Development Committee, constituted under the auspices of the Government of India, has had under consideration the question of revising the medical curriculum so as to shed much of the unnecessary load that is placed on the medical student and of improving the content of the subjects taught and the method of teaching, particularly for the purpose of giving a preventive bias to the outlook of the student. The proposed changes in the curriculum will, it is hoped, enable the doctor of the future to offer to the people of India both curative and preventive health service in an effective manner.

Other subjects considered by the Committee

(which, with its sub-committees, held meetings between July 1 and 15) included the place of the indigenous systems of medicine and of homeopathy in the future programme of medical relief for the country, the health of the school population, the control of venereal diseases, prevention of smallpox, physical education, health education and publicity, the problem of nutrition and control of food adulteration.

Groups of members of the Committee will shortly undertake tours in the provinces of Delhi, the U.P., Bihar, Orissa, Bengal and the C.P. Industrial centres in Northern India will also be visited. These tours will complete the rapid survey of existing health conditions in British India by the Committee, that has been in progress during the past few months.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory during the month of July 1944, there were four of slight and one of moderate intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin (I.S.T.)	Epicentral distance from Bombay	Co-ordinates of epicentre	Depth of focus
		H. M.	(Miles)		(Miles)
17	Slight	17 24	2180
19	Slight	16 51	4330
23	Slight	18 28	1300
27	Slight	16 34	6420
27	Moderate	14 49	1480	Lat. 11° 7' N., Long. 95° 0' E. near the Andaman Islands.	110

MAGNETIC NOTES

Magnetic conditions during June 1944 were slightly more disturbed than in the previous month. There were 20 quiet days and 10 days of slight disturbance as against 20 quiet days and 10 days of slight disturbance during the same month last year.

The quietest day during the month was the 24th and the day of the largest disturbance the 15th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	
1-3, 6-8, 10-12, 16-21, 24, 25, 27, 28, 30	4, 5, 9, 13-15, 22, 23, 26, 29	

No magnetic storm occurred during the month of June in 1943 and 1944.

The mean character figure for the month of June 1944 was 0.33 as against 0.67 for June 1943.

Magnetic conditions during July 1944 were less disturbed than in the previous month. There were 27 quiet days and 4 days of slight disturbance, as against 7 quiet days and 24 days of slight disturbance during the same month last year.

The quietest day during the month was the 25th and the day of largest disturbance was the 9th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	
1-8, 10-13, 15-18, 21-31	9, 14, 19, 20	

No magnetic storm occurred during the month of July in 1943 and 1944.

The mean character figure for the month of July 1944 was 0.13 as against 0.77 for July 1943.

M. PANDURANGA RAO.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 92, No. 4665.

"Journal of Agricultural Research," Vol. 68, Nos. 5-6.

"Agricultural Gazette of New South Wales," Vol. 55, Nos. 1 to 4.

"Endeavour," Vol. 3, No. 10.

"Experiment Station Record," Vol. 90, No. 4.

"Transactions of the Faraday Society," Vol. 40, Pt. 5.

"Indian Forester," Vol. 70, No. 7.

"Horticultural Abstracts," Vol. 13, No. 4; Vol. 14, No. 1.

"The Indian Journal of Horticulture," Vol. 1, No. 2.

"Central Board of Irrigation Bulletin," Vol. 1, No. 3.

"Bulletin of the Indian Central Jute Committee," Vol. 6, Nos. 11-12; Vol. 7, Nos. 2-3.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 39, Nos. 2-3.

"Indian Medical Gazette," Vol. 79, No. 6.

"The Review of Applied Mycology," Vol. 23, Nos. 3-4.

"Bulletin of the American Meteorological Society," Vol. 25, No. 2.

BOOKS

The Application of Radiant Heat of Metal Finishing—A Critical Survey of the Infra-Red Process for the Storing of Paints and Enamels. By J. H. Nelson. (Chapman and Hall, Ltd., London, W.C. 2), 1944. Pp. 79. Price 8sh. 6d.

Metallurgical Analysis. By V. Gopalram Iyer, (Benares Hindu University), 1943. Pp. 365 + 11. Price Rs. 12.

ERRATA

Vol. 13, No. 7:

Page 177, Contents, right column, 9th line: Read "Ovule" for "Value".

Page 186, heading of Note entitled "The Origin of the Haustoria", etc.: Read "Ovule" for "Value".

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